

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 20 OCT 2005

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Applicant's or agent's file reference TS 6439 PCT		<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/EP2004/051602		International filing date (day/month/year) 26.07.2004	Priority date (day/month/year) 11.08.2003	
International Patent Classification (IPC) or national classification and IPC E21B47/12, E21B47/06				
Applicant SHELL INTERNATIONAL RESEARCH MAATSCHAPPIJ BV et al				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 7 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 5 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in Item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (Indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  03.06.2005		Date of completion of this report  19.10.2005		
Name and mailing address of the International preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Morrish, S  Telephone No. +49 89 2399-7220		

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**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2004/051602

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1, 3-9	as originally filed
2	filed with telefax on 10.06.2005

**Claims, Numbers**

8(part), 9-14	as originally filed
1-7, 8(part), 15-20	filed with telefax on 10.06.2005

**Drawings, Sheets**

1/2, 2/2	as originally filed
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- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-20
	No: Claims	
Inventive step (IS)	Yes: Claims	1-20
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-20
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

## **I Basis of the Report**

The comments made by the Applicant in his letter dated the 21st September 2005 have been considered by the Examining Division. The request for additional fees was indeed made for two additional inventions, whereas only one additional invention should have been requested.

This error notwithstanding, the Division has also re-examined the inventive concept behind the two embodiments claimed by the applicant and has decided that although the features defined in the subject-matter of claim 1 solve the problem as defined by the Applicant himself and discussed on page 2 of the description, that of inserting a double-ended optical cable into a small diameter guide conduit, the additional problem of ensuring optical continuity within the cable is solved by both the continuous cable of claim 1 and by the mirror in claim 5. Assuming therefore that the cable within the nose section of claim 5 has the same characteristics as that of claim 1, so that both nose sections can fit into the guide conduit as required, both claims are linked by the general inventive concept of ensuring optical continuity through this said nose section.

The Examining Division has therefore requested that the Applicant receives a full refund to both additional inventions paid under protest.

## **V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

### **V1 Claims 1 to 4 and 10 to 20**

The document **D1: WO 00/49273** is regarded as being the closest prior art to the subject-matter of **claim 1** and discloses a method of installing a double-ended distributed sensing optical fibre assembly within a guide conduit, the method comprising:

- a) providing a nose section, which interconnects the proximal ends of two sections of distributed sensing fibre optical cable such that light transmitted along the length of one section of fibre optical cable is transmitted via the nose section into the other section of fibre optical cable;
- b) inserting the nose section into the guide conduit such that the nose section moves

through the guide conduit ahead of said two sections of distributed sensing fibre optical cable that are interconnected thereby; and  
c) connecting the distal ends of the sections of distributed sensing fibre optical cable to a light transmission and receiving unit.

The subject-matter of **claim 1** differs from this known **D1** in that the nose section has an outer width (W) of less than 1 cm and that the two sections of distributed sensing fibre optical cable interconnected thereby are formed from a single fibre optical cable, which is bent into a U-shaped configuration in the region of the nose section and the fibre optical cable is stretched in said region such that the fibre optical cable has a smaller width in the region of the nose section than in most other parts of the fibre optical cable.

Therefore the subject-matter of **claim 1** is therefore new and meets the requirements of Article 33(2) PCT.

The problem to be solved by the present invention may be regarded as being able to insert a U-shaped fibre optic cable into a small diameter conduit (about ten times smaller than of known conduits, which in the case of **D1** is coiled tubing) and to ensure it's optical continuity through the two stretched sections of the optical cable.

The solution to this problem proposed in **claim 1** of the present application is therefore considered as involving an inventive step (Article 33(3) PCT).

**Claims 2 to 4 and claims 10 to 20** are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

## **V2 Claims 5 to 9**

The document **D1: WO 00/49273** is also regarded as being the closest prior art to the subject-matter of **claim 5** and discloses a method of installing a double-ended distributed sensing optical fibre assembly within a guide conduit, the method comprising:

- a) providing a nose section, which interconnects the proximal ends of two sections of distributed sensing fibre optical cable such that light transmitted along the length of one section of fibre optical cable is transmitted via the nose section into the other

- section of fibre optical cable;
- b) inserting the nose section into the guide conduit such that the nose section moves through the guide conduit ahead of said two sections of distributed sensing fibre optical cable that are interconnected thereby; and
- c) connecting the distal ends of the sections of distributed sensing fibre optical cable to a light transmission and receiving unit.

Therefore the subject-matter of **claim 5** is therefore new and meets the requirements of Article 33(2) PCT.

The problem to be solved by the present invention may be regarded as being able to ensure optical continuity through two ends of a discontinuous optical cable once it is inserted into a small diameter conduit.

The solution to this problem proposed in **claim 5** of the present application is therefore considered as involving an inventive step (Article 33(3) PCT).

**Claims 6 to 9** are dependent on claim 5 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

## **VII Certain defects in the international application**

Independent claims 1 and 5 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

The features of the preamble of claims 1 and 5 are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

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(SEPARATE SHEET)**

International application No.

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centimeters and they are not configured to be installed in small diameter guide conduits.

An object of the present invention is to provide a method for installing a double ended distributed sensing fiber optical assembly within a small diameter guide conduit.

#### SUMMARY OF THE INVENTION

The method according to the invention for installing a double ended distributed sensing optical fiber assembly within a guide conduit comprises:

- providing a nose section, which interconnects the proximal ends of two sections of distributed sensing fiber optical cable such that light transmitted along the length of one section of fiber optical cable is transmitted via the nose section into the other section of fiber optical cable;
- inserting the nose section into the guide conduit such that the nose section moves through the guide conduit ahead of said two sections of distributed sensing fiber optical cable that are interconnected thereby;
- connecting the distal ends of the sections of distributed sensing fiber optical cable to a light transmission and receiving unit; and
- wherein the nose section has an outer width (W) which is less than 1 cm the nose section and the two sections of distributed sensing fiber optical cable interconnected thereby are formed from a single fiber optical cable, which is bent into a U-shaped configuration in the region of the nose section and the fiber optical cable is stretched in said region such that the fiber optical cable has a smaller width in the region of the nose

EPO - DG 1  
10.06.2005  
(71)



C L A I M S

1. A method of installing a double ended distributed sensing optical fiber assembly within a guide conduit, the method comprising:

5 - providing a nose section, which interconnects the proximal ends of two sections of distributed sensing fiber optical cable such that light transmitted along the length of one section of fiber optical cable is transmitted via the nose section into the other section of fiber optical cable;

10 - inserting the nose section into the guide conduit such that the nose section moves through the guide conduit ahead of said two sections of distributed sensing fiber optical cable that are interconnected thereby;

15 - connecting the distal ends of the sections of distributed sensing fiber optical cable to a light transmission and receiving unit; and

20 wherein the nose section has an outer width (W) which is less than 1 cm the nose section and the two sections of distributed sensing fiber optical cable interconnected thereby are formed from a single fiber optical cable, which is bent into a U-shaped configuration in the region of the nose section and the fiber optical cable is stretched in said region such that the fiber optical cable has a smaller width in the region of the nose  
25 section than in most other parts of the fiber optical cable.

2. The method of claim 1, wherein the nose section has an outer width W which is less than 5 mm and the guide conduit has an internal width which is less than 10 mm.

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3. The method of claim 1, wherein the fiber optical cable is heated when it is stretched and the bent section of stretched fiber optical cable is embedded in a nose-shaped body of material having a lower light reflection index than the stretched fiber optical cable embedded therein.

4. The method of claim 3, wherein said nose shaped body has a substantially cylindrical shape and an outer diameter less than 3 mm.

5. A method of installing a double ended distributed sensing optical fiber assembly within a guide conduit, the method comprising:

- providing a nose section, which interconnects the proximal ends of two sections of distributed sensing fiber optical cable such that light transmitted along the length of one section of fiber optical cable is transmitted via the nose section into the other section of fiber optical cable;

- inserting the nose section into the guide conduit such that the nose section moves through the guide conduit ahead of said two sections of distributed sensing fiber optical cable that are interconnected thereby;

- connecting the distal ends of the sections of distributed sensing fiber optical cable to a light transmission and receiving unit; and

wherein the nose section has an outer width (W) which is less than 1 cm and the two sections of distributed sensing fiber optical cable are interconnected by a nose section which comprises a light reflecting element, such as a mirror, which is configured to transmit light emitted from a proximal end of one section of distributed sensing fiber optical cable into a proximal end of the other section of distributed sensing fiber optical cable.

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6. The method of claim 5, wherein the nose section has an outer width W which is less than 5 mm and the guide conduit has an internal width which is less than 10 mm.

5 7. The method of any preceding claim, wherein the light transmitting and receiving unit is configured to transmit light pulses or pulsed and continuous waves alternately or simultaneously into each distal end of each of said two sections of distributed sensing fiber optical cable and to acquire distributed sensing data from light  
10 backscattered from different points along the length of the two sections of fiber optical cable to the distal end into which the light pulses are transmitted.

15 8. The method of claim 7, wherein the distributed sensing fiber optical assembly is configured as a distributed temperature and/or distributed pressure sensor assembly, and wherein each section of distributed sensing fiber optical cable passes through a reference

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15. The method of claim 14, wherein a plurality of fiber optical sensing assemblies extend side by side through the protective stainless tube, which sensing assemblies monitor different physical parameters such as pressure, temperature and/or acoustic data and which is coupled to a series of flow, pressure, temperature, acoustic and/or seismic data monitoring assemblies.

16. The method of claim 1, wherein at least substantial parts of the two sections of the double ended fiber optical cable are arranged side by side in a jacketed flexible protective tube, which is provided with a moulded end cap in which the nose section is arranged.

17. The method of claim 1, wherein the guide conduit has a substantially straight shape and is at a lower end thereof equipped with a check valve, such that when the double ended fiber and nose section are pumped into the guide conduit the pump fluid is discharged from the guide conduit through the check valve.

18. The method of claim 1, wherein the optical fiber assembly is inserted into the guide conduit which extends into a subsea well by means of a remotely operated subsea pod, which is removably mounted on a subsea wellhead.

19. The method of claim 14, wherein the protective stainless steel tube is arranged within a larger OD stainless steel tube, such as a 1/4" (6 mm OD) control.

20. The method of claim 1, wherein the guide tube is formed by the casing of an oil and/or gas production well and the double ended distributed sensing optical fiber assembly is strapped to the production tubing of the oil and/or gas production well, or otherwise inserted into the well.